Yolk Pigmenting Value of Dried Kenaf Tops

Jack L. Fry, George M. Herrick, and R. H. Harms

Kenaf (*Hibiscus cannibus L.*) is a tall, woody, annual plant which produces a long, unbranched stem when grown in dense stands. It is native to Africa where it is used for both food and fiber. It is widely cultivated for fiber production in the tropics and subtropics, including many Latin American countries.

There has recently been much interest in the use of kenaf in animal feeds and as a pulp source for paper manufacture. New varieties of kenaf have been developed by Wilson et al. (1965). When Everglades-41 variety was at about the 6 foot growth stage, it was found by Wing (1967) to make a silage comparable to that of most high quality roughages.

In paper manufacturing it is probable that the leaves will be recovered, dried, and made available to the feed industry as kenaf leaf meal. It has been suggested that this meal might replace alfalfa as a xanthophyll source in the diets of laying hens and broilers. The study herein reported is an investigation of the potential of kenaf as a pigmenter of egg yolks.

Materials and Methods

Dehydrated kenaf tops were used in two trials to replace alfalfa in the diets of egg production type hens. The kenaf meal was prepared from plants approximately 125 days old. The top

TABLE 1
Basal diet composition

Ingredient	Percent
Degerminated white corn meal	68.00
Soybean meal (50 percent protein)	20.80
Ground limestone	5.90
Defluorinated phosphate	1.95
Salt	.25
Vitamin and trace mineral mix[1]	.50
Sand	2.60

[1] Supplied per kilogram of diet: 6,600 I.U. vitamin A, 2,200 I.C.U. vitamin D_3, 500 mg. choline chloride, 40 mg. niacin, 4.4 mg. riboflavin, 13 mg. pantothenic acid, 22 mcg. vitamin B_{12}, 125 mg. ethoxyquin, 20 mg. iron, 2 mg. copper, 200 mcg. cobalt, 1.1 mg. iodine, 100 mcg. zinc, 71 mg. manganese, and 2.2 mg. menadione sodium bisulfite.

36 inches of the plants (Everglades-41 variety) were dried and then ground in a Wiley mill. The composition of the pigment-free basal diet is shown in Table 1. In the first trial the kenaf and alfalfa leaf meal (20 per cent protein) were incorporated into the diet at 2½ per cent and 5 per cent each. When the kenaf and alfalfa were added to the diet, adjustments were made in the level of corn, soybean meal and sand in order to keep the diets iso-caloric and iso-nitrogeneous. The nutrient analysis of ingredients according to Maddy et al. (1963) was used as a basis for these formulations. A synthetic pigmenter, beta-apo-8′-carotenal, was used as a "control" at levels of 30, 60, 90, and 120 grams per ton of basal.

Eighty individually caged hens which had been in production approximately 10 months were depleted of pigment by feeding the basal diet (Table 1) for 35 days. At this time yolk color was evaluated visually using a color rotor (Heiman and Carver, 1935) and found to have an average score of 5.5. The hens were then randomized into groups of ten and one group placed on each of the treatments. Visual color rotor scores were obtained on all eggs collected during a 14-day repletion feeding period.

In the second trial the alfalfa and kenaf were included in the test diets on the basis of analyzed xanthophyll content. Kenaf meal (71 mg xanthophyll per pound) was used at 5 per cent of the diet whereas alfalfa leaf meal (105 mg xanthophyll per pound) was used at 3.38 per cent of the diet. Levels of 30, 60, and 90 grams of beta-apo-8′-carotenal were fed; twenty pigment-depleted hens were on each of the five test diets. Yolk color scores were obtained as previously described.

Results and Discussion

Maximum yolk pigmentation occurred between the 10th and 14th day after repletion feeding began. The maximum average scores for each test diet in both trials are presented graphically in Figures 1 and 2.

Color rotor scores of eggs from hens fed the diet containing 2½ per cent alfalfa equalled that of the group fed 5 per cent kenaf in the first trial (Fig. 1). Color scores of eggs from hens fed 5 per cent alfalfa were two units higher than these groups. When comparing the values obtained when increasing levels of

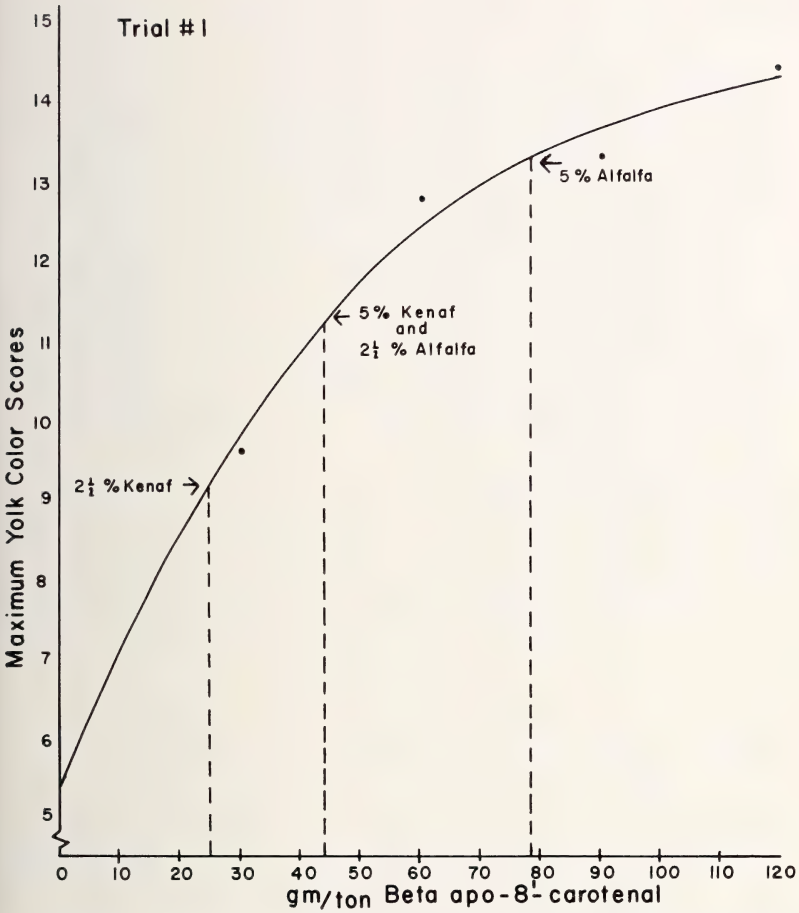

Figure 1. Yolk pigmentation by beta-apo-8′-carotenal, alfalfa, and kenaf (trial 1).

beta-apo-8′-carotenal were fed it appears that utilization of pigment in the feed does not result in a linear relationship with the amount of pigment present in the feed.

A comparison of the values obtained for the two different levels of kenaf and alfalfa with their equivalents in pigmenting value by beta-apo-8′-carotenal suggests a similar non-linear relationship of pigmentation and ingredient level. Higher levels of

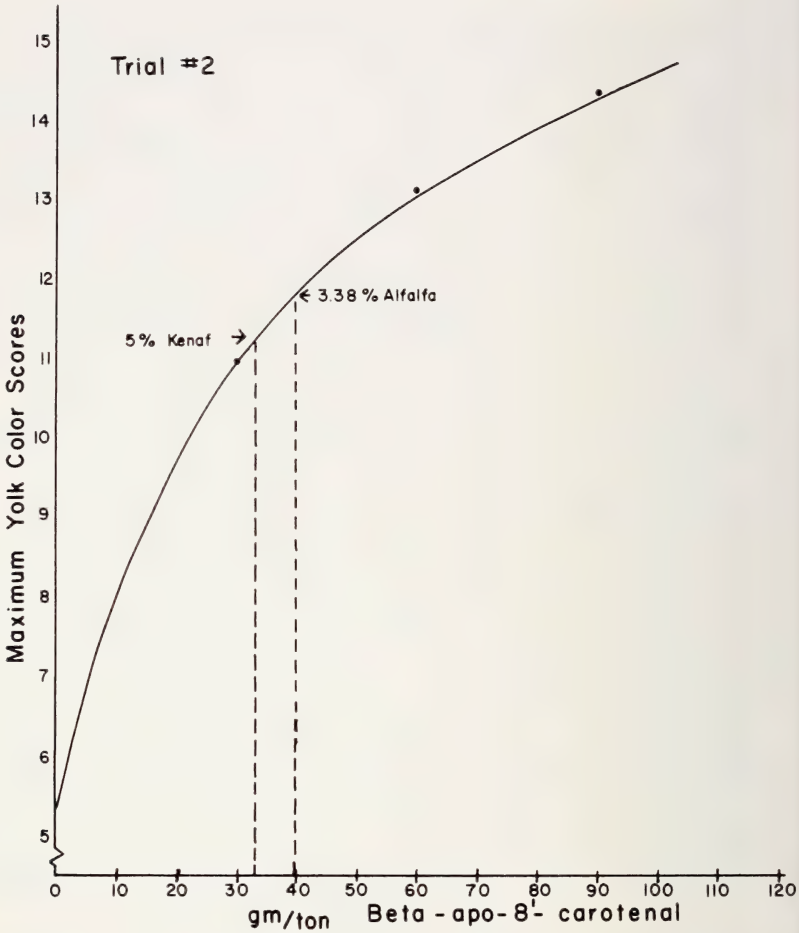

Figure 2. Yolk pigmentation by beta-apo-8′-carotenal, alfalfa, and kenaf (trial 2).

these ingredients would no doubt be less effective per xanthophyll unit.

Although kenaf was only one-half as effective as alfalfa when used on an equivalent weight basis, xanthophyll determinations indicated that 3.38 per cent alfalfa should be equivalent to 5 per cent kenaf in the diet. When these levels were used in trial 2 (Fig. 2) yolk color scores of 11.8 and 11.3 were obtained for

alfalfa and kenaf, respectively, indicating a less efficient utilization of the xanthophyll in kenaf.

It is apparent that the laying hen can utilize the xanthophyll in kenaf; however, the xanthophyll level in kenaf is not as high as in alfalfa leaf meal and it appears that the biological activity is not as high. It should be pointed out that the kenaf used in these studies was from the top 36 inches of plants of 125 days maturity. It has been suggested that a better source for this purpose might be (1) the top 24 inches of the plant, (2) stripped leaves of plants of this maturity, or (3) the entire plant at about the 6 foot stage of maturity. It has been estimated (Killinger, personal communication) that approximately two tons of oven dry kenaf meal could be produced per acre from kenaf at the 6 to 7 foot growth stage.

All of these three sources would be expected to have higher xanthophyll and protein content and less fiber than the sample used in this study. Also, the sample was stored (55-60F.) for approximately 3 months prior to use; since no anti-oxidant was added there may have been a significant loss of xanthophyll.

Summary

Two experiments were conducted with egg production type hens to evaluate dehydrated kenaf tops as a source of xanthophyll in poultry feeds. Kenaf at 5 per cent of the diet produced acceptable yolk pigmentation but was not as effective as alfalfa on either a weight basis or a xanthophyll content basis.

Further study of other kenaf sources is warranted since there is the possibility of kenaf being readily available as a feed ingredient for yolk pigmentation.

Acknowledgments

The kenaf for this study was supplied by Dr. R. V. Allison, Everglades Experiment Station, Belle Glade, Florida, 33430, and the beta-apo-8′-carotenal by Hoffman-LaRoche, Inc., Nutley, New Jersey. Appreciation is expressed to Mr. T. P. Moffses for his assistance and to Mrs. Mary Maud Sharpe for the xanthophyll determinations.

Literature Cited

Heiman, V., and J. S. Carver. 1935. The yolk color index. U. S. Egg Poultry Magazine, vol. 41, no. 8, page 40-41.

Maddy, K. H., R. B. Grainger, W. A. Dudley, and F. Puchal. 1963. The application of linear programming to feed formulation. Feedstuffs, vol. 35, no. 15, pages 28-30, 70-73.

Wilson, F. D., T. E. Summers, J. F. Joyner, D. W. Fishler, and C. C. Seale. 1965. "Everglades 41" and "Everglades 71", two new varieties of kenaf for fiber and seed. Cir. S-168, Florida Agr. Exp. Sta.

Wing, J. M. 1967. Ensilability, acceptability and digestability of kenaf. Feedstuffs, vol. 39, no. 29, page 26.

Department of Poultry Science, University of Florida, Gainesville, Florida 32601. Florida Agr. Exp. Sta. Journal Series No. 2949.